Space Weather Technical Forecast

Issued on Tuesday, 15 March 2022 at 00:41 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of G1/Minor geomagnetic storm early on Day 1 (15 Mar), otherwise slowly declining. Chance of M-class flares. Chance of Active fluence by Days 2-4 (16-18 Mar).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate over the past 24 hours, with an M2 flare at 14/0840 UTC from AR2965. There are currently four sunspot regions on the visible disc. The largest and most complex of these is AR2965. AR2960 is large but stable, and will be rotating off the Earth-side of the disc towards the end of Day 1 (15 Mar). The other regions are all small and simple. There is one slow weak CME observed on 13 March which may give a glancing blow at Earth on day 3 (17th). A couple of CMEs have been observed in recent coronagraph imagery, one emerging southwards, which looks to be far-sided, although the source is unknown. Another CME has recently emerged off the southwest, which also looks far-sided, probably associated with ex-2964. Both of these CMEs are currently undergoing further analysis, but are unlikely to be Earth-directed. No other Earth-directed CMEs were observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds, as observed by DSCOVR at L1, showed the effects of a CME which arrived at 13/1014 UTC. Solar wind speeds have been slightly elevated throughout the period, with a peak of 470km/s at 14/0032UTC. Density ranged from average to above average at the start of the period, peaking at 18ppcc at 14/0839, declining to the current below average values of below 5ppcc.The IMF, Bt, started strong, with a peak of 25nT around 14/0600UTC, before a gradual decline to moderate levels. The north-south component, Bz, started the period strong, with a peak of 24nT at 14/0649UTC, before a steady decline to weak values, below 5nT. Phi angle started the period positive (away from the sun), with an abrupt change in orientation to negative (towards the sun) from 14/0630UTC. Geomagnetic activity reached G2/Moderate Storm interval (Kp 6) between 14/0000-0300, but has been Quiet to Unsettled since then, as the CME influence begins to wane.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) measured at GOES 16 was at background levels throughout. The high energy electron flux (greater than 2 MeV) has been moderate to background levels. The 24-hour integrated electron fluence was below the Active (1e8 integrated pfu) threshold. Observed fluence at 15/0000 UTC was 1.55e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be mainly Low, perhaps Moderate, with a chance of M-class flares. The risk of M-flares mainly comes from AR2965.

Solar Wind / Geomagnetic Activity: Ongoing CME effects are expected to gradually decline through Day 1 (15 Mar). There is a risk of further periods of negative Bz, although it is currently strongly positive. There is also a slight chance of a glancing blow from a weak CME on Day 3 (17 Mar). No coronal hole effects are currently expected during this period.

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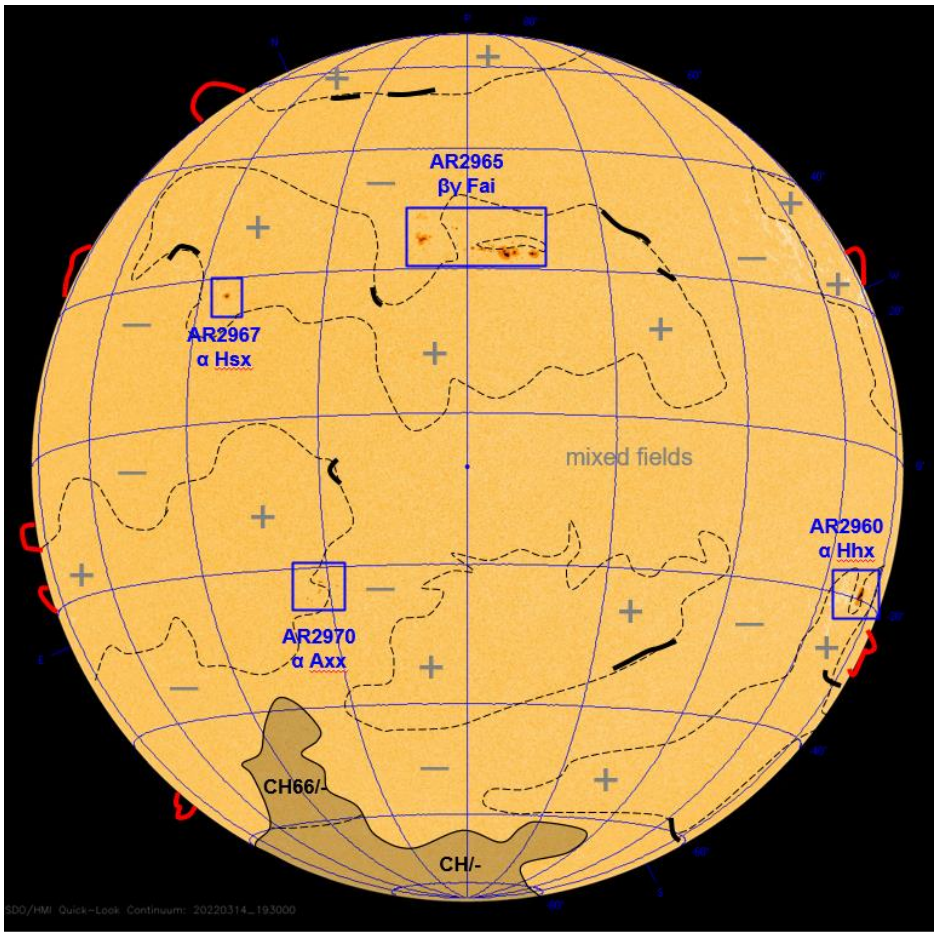
Geomagnetic activity is expected to be Quiet to Active, with a chance of further G1/Minor Storm intervals if we do see any further periods of negative Bz. The risk of G1 intervals declines through Day 1 (15 Mar), with mainly Quiet activity returning, although there is a very slight chance of an increase in activity if we do see the weak CME on Day 3 (17 Mar).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain predominantly at background levels, although there is just a very slight chance of an increase in response to any larger flares that may occur.

The high energy (greater than 2 MeV) electron flux is currently at background levels. Some charging may have occurred from the recent CME, so a rise in electron levels is possible from Day 1 (15 Mar) onwards, with some uncertainty as to the level of any charging. The electron fluence is likely to follow a rising trend if we see an electron response, with a chance of reaching the Active (1e8 integrated pfu) threshold on Days 2-4 (16-18 Mar), although some uncertainty from Day 3 (17 Mar) if we do see the arrival of a weak CME.

Figure 1. Solar Analysis Valid 14/1930 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A CME arrival occurred yesterday, reaching L1 at 13/1014 UTC. This was likely the arrival of the large halo CME emitted by the long duration C-class flare from ex-AR2962 on the 10th, but perhaps incorporates some element from a filament eruption on the 9th March. Solar wind speeds are currently slightly elevated, with the CME effects expected to gradually decline through Day 1 (15 Mar). The magnetic flux rope of the CME could potentially bring further periods of negative (southward) orientation, with the Bz currently weakly positive. There is also a slight chance of a glancing blow from a weak CME on Day 3 (17 Mar), but the bulk of the ejecta is expected to pass below Earth. No coronal hole effects are currently expected during this period.

Geomagnetic activity is expected to be Quiet to Active, with a chance of further G1/Minor Storm intervals if we do see any further periods of negative Bz, mainly early on Day 1 (15 Mar). The risk of G1 intervals declines through Day 1 (15 Mar), with mainly Quiet activity returning, although there is a very slight chance of an increase in activity if we do see the weak CME on Day 3 (17 Mar).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	20	1	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

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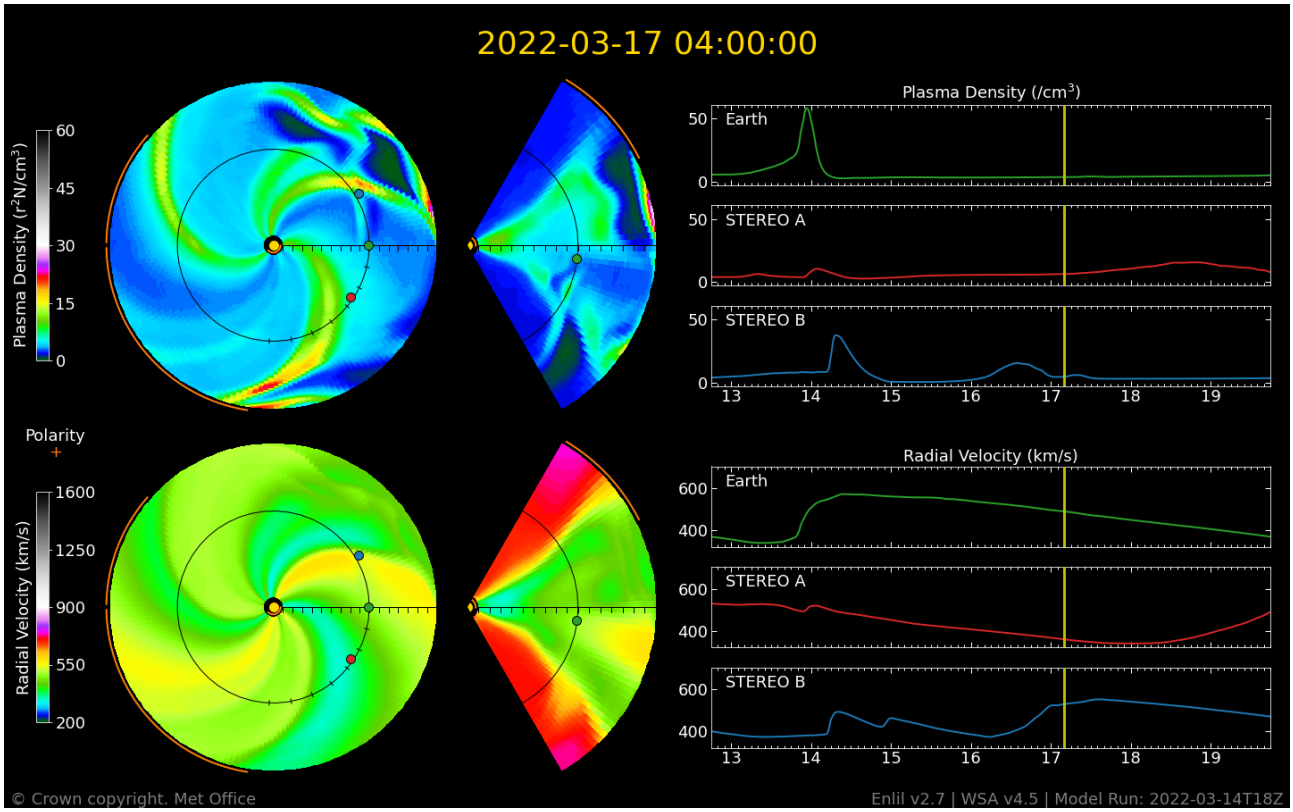
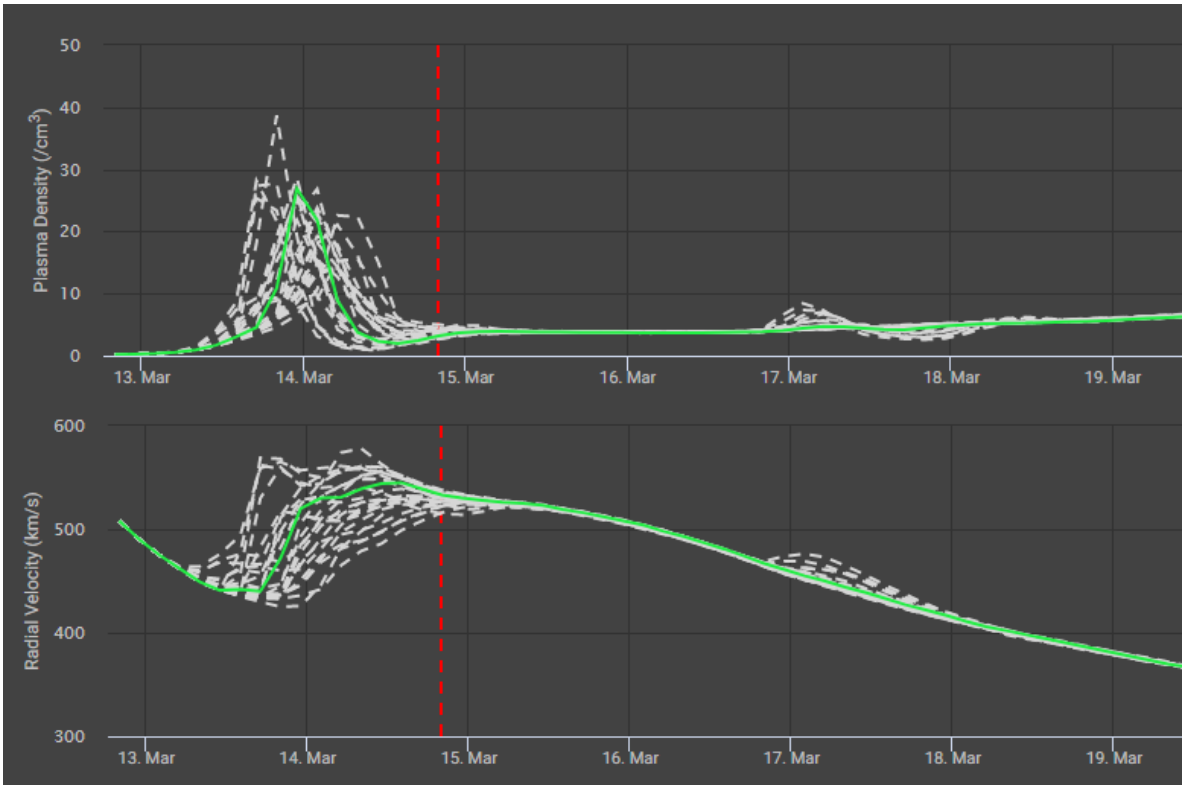
Figure 2: Enlil and ensemble showing a slight chance of a weak CME passing close to Earth on Day 3 (17th March).





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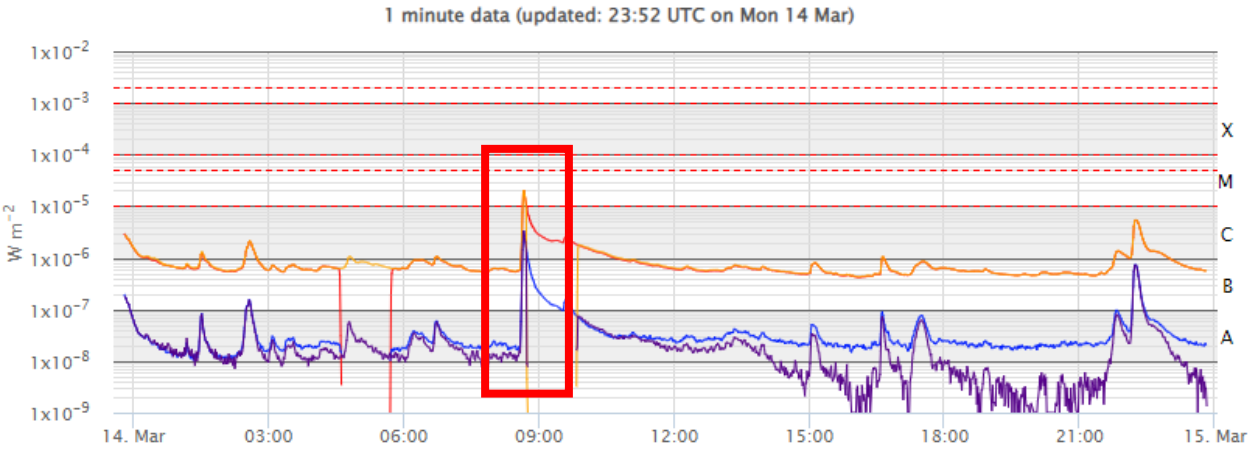
Radio Blackouts - X-Ray Flares:

There are currently four numbered sunspot regions on the visible disc, with Moderate solar activity. The largest flare was an M2 at 14/0840 UTC from AR2965. This region is approaching centre disc in the northern hemisphere, classified Fai/Beta-gamma, with its intermediate spots continuing to show rudimentary penumbra. AR2960 is a large Hhx/Alpha spot in the southwest but has remained stable, with no flare activity observed. The other spots are all small and simple unipolar regions.

Activity is expected to be Low, with a chance of increasing to Moderate again from any M-flares, with the main risk from AR2965.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	25	25	25	25
Very Active	R3 to R5 X Class	No	2	2	2	2

Figure 3: GOES-16 X-Ray flares – shows the recent M-class flare, which originated from AR2965.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (10MeV) measured at GOES 16 is currently at background levels. There is just a very slight chance of an S1/Minor radiation storm in the event of larger flares occurring, mainly from AR2965.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	2	2	2
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

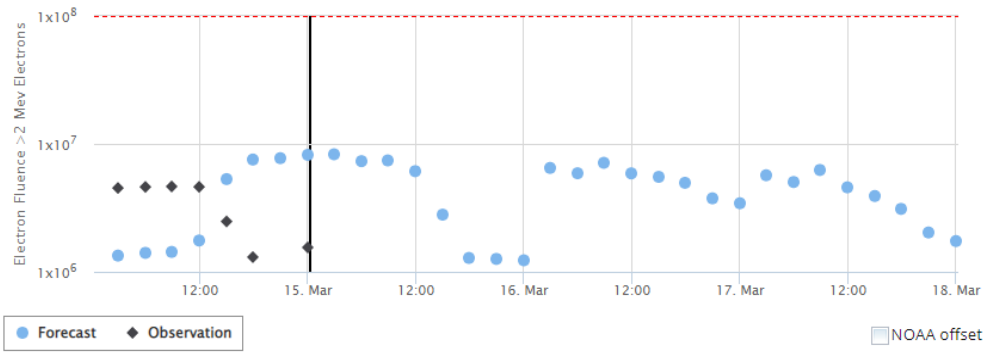
High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux as observed at GEO by GOES-16 is currently at background levels. The recent CME arrival has suppressed electron flux levels, but some charging may have occurred from the higher wind speeds, although these higher wind speeds were relatively short lived. Therefore a rise in electron levels is possible from Day 1 (15 Mar) onwards, although some uncertainty remains as to the level of charging we may have experienced.

The associated 24 hour electron fluence is likely to follow a rising trend if we see an electron response to this CME, but currently confidence is low as to whether it is likely to reach the Active (1e8 integrated pfu) threshold, with a chance on Days 2-4 (16-18 Mar), but with some uncertainty due to the potential glancing blow from a weak CME on Day 3 (17 Mar).

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	30	30	20	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: REFM observations and forecast.



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